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13. SUPPLEMENTARY NOTES

14. ABSTRACT

The US Army's Armament Research, Development, and Engineering Center (ARDEC) at Picatinny Arsenal in Rockaway Township, N.J., was commissioned to reduce the weight of the 155mm howitzer. Their efforts included replacing an approximately 4' x 10' x 1" steel ISO grid support panel with one made of titanium 6AL-4V. Titanium weighs 45 percent less than steel, is stronger and more resilient, and doesn't rust. However, its unique properties also make it difficult to machine productively. ARDEC was spending excessive time milling a pattern of 2.25"-wide triangular pockets into the grid to further reduce its weight. ARDEC presented this problem to the National Center for Defense Manufacturing & Machining (NCDMM) and requested their assistance.

15. SUBJECT TERMS
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ISO Grid 155 mm Howitzer

NCDMM Project No. 03-0008-09

Technical Report

PROBLEM / OBJECTIVE

The US Army's Armament Research, Development, and Engineering Center (ARDEC) at Picatinny Arsenal in Rockaway Township, N.J., was commissioned to reduce the weight of the 155mm howitzer. Their efforts included replacing an approximately 4' x 10' x 1" steel ISO grid support panel with one made of titanium 6AL-4V. Titanium weighs 45 percent less than steel, is stronger and more resilient, and doesn't rust. However, its unique properties also make it difficult to machine productively. ARDEC was spending excessive time milling a pattern of 2.25"-wide triangular pockets into the grid to further reduce its weight. ARDEC presented this problem to the National Center for Defense Manufacturing & Machining (NCDMM) and requested their assistance.

The “proof-of-concept” mockup part used to test new tooling and manufacturing processes

ACCOMPLISHMENTS / PAYOFF

Process Improvement

High chip loads are required to mill titanium productively. In light cuts, the alloy's resilience will cause a cutting tool to rub instead of cut, generating heat, high pressures, and short tool life. But heavy cuts require high torque and can also generate heat, so a balance of parameters is required. NCDMM’s alliance partner, Kennametal Inc., recommended a combination of advanced tooling and manufacturing techniques to boost productivity. Solid-carbide center-cutting endmills were tested using trichoidal programming techniques. These machining methods employ radial movement of the cutter to maintain constant feed rates and keep the endmill continuously in the cut, maximizing milling efficiency.

Implementation and Technology Transfer

ARDEC will be implementing NCDMM's recommendations on a horizontal machining center using 200 pounds per square inch (psi) flood coolant, which facilitated removal of chips. The end mills ran at cutting speeds 100 percent higher than the 80-100 surface feet per minute (sfm) speeds used previously. Feed rate was increased proportionately to balance chip load. Machining time for the grid dropped from 400 hours to 120 hours, a reduction of 70 percent. Surface finish improved from 80 root mean squared (rms) to below 32 rms. ARDEC engineering technician, Bill Bakula, said, "We did a 6" x 12" sample part, and the NCDMM tried different speeds and feeds and different tooling. The results,” he said, “were great. This brings us up to date with new techniques."

Expected Benefits

In summary, implementation produced:

- 70 percent milling time reduction
- Surface finish improved by over 200%
- A lighter, stronger, corrosion-resistant component produced more efficiently

At a nominal machine time rate of $60 per hour, savings in machining time alone amount to $14,000 per grid. Over the entire intended production run of 600 lightweight howitzers, machine time savings would total $8.4 million. Less quantifiable but nevertheless real further savings include reduced expenditure of energy in transporting the howitzers. Most importantly, the lighter weapons will enhance the responsiveness of the units that use them.

TIME LINE / MILESTONE

Start Date ..... Sept 03
End Date ..... Feb 04

PROJECT FUNDING

NCDMM funding $10K

PARTICIPANTS

ARDEC/ Picatinny Arsenal
NCDMM
Kennametal Inc.

For additional information concerning this project, contact the NCDMM at www.ncdmm.org